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Hydrogen-Rich Gas Generators To Reduce Air Pollution and Improve Gasoline Economy

Two new gas generators have been developed which produce hydrogen-rich gas from a gasoline/air mixture. These units can be utilized with a spark-ignition engine for reducing air pollution and improving gasoline economy. These generators are similar to those described in Tech Brief B75-10203 (NPO-13342 and NPO-13464), but they do not use water in the process. One of the new generators operates strictly thermally, the other is based on a catalytic reaction. Both are compact enough for use in automobiles.

The thermal gas generator is shown in Figure 1. It consists of a burner, a reaction chamber, and a heat exchanger. The generation of hydrogen-rich gas is initiated by pumping air into the heat exchanger. The air is heated as it passes around hot baffled tubes. The

hot air then is fed through the burner into the reaction chamber. As it moves through the burner, the air is given a swirling motion to allow thorough mixing with the fuel fed by a nozzle into the reaction chamber. This mixture is ignited by a spark plug causing partial oxidation, and the product gas is exhausted through the heat-exchanger tubes into the engine.

Steady-state operation occurs when the air reaches a preset temperature as it leaves the heat exchanger. This is sensed by a thermocouple which directs a two-way control valve to switch the fuel supply into a vaporization coil. Heat from the reaction chamber vaporizes the fuel in the coil. At this point the vaporized fuel is mixed with a hot airstream before the burner, and the vaporized, preheated mixture is fed into the reaction chamber to produce hydrogen-rich gas.

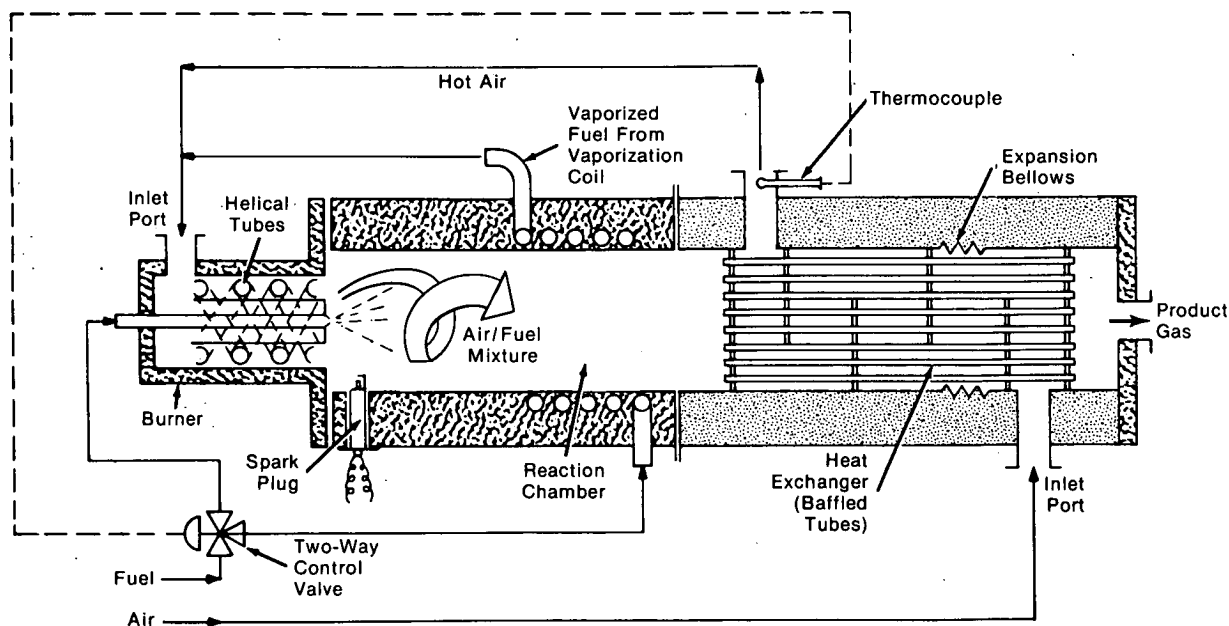


Figure 1. Thermal Gas Generator

(continued overleaf)

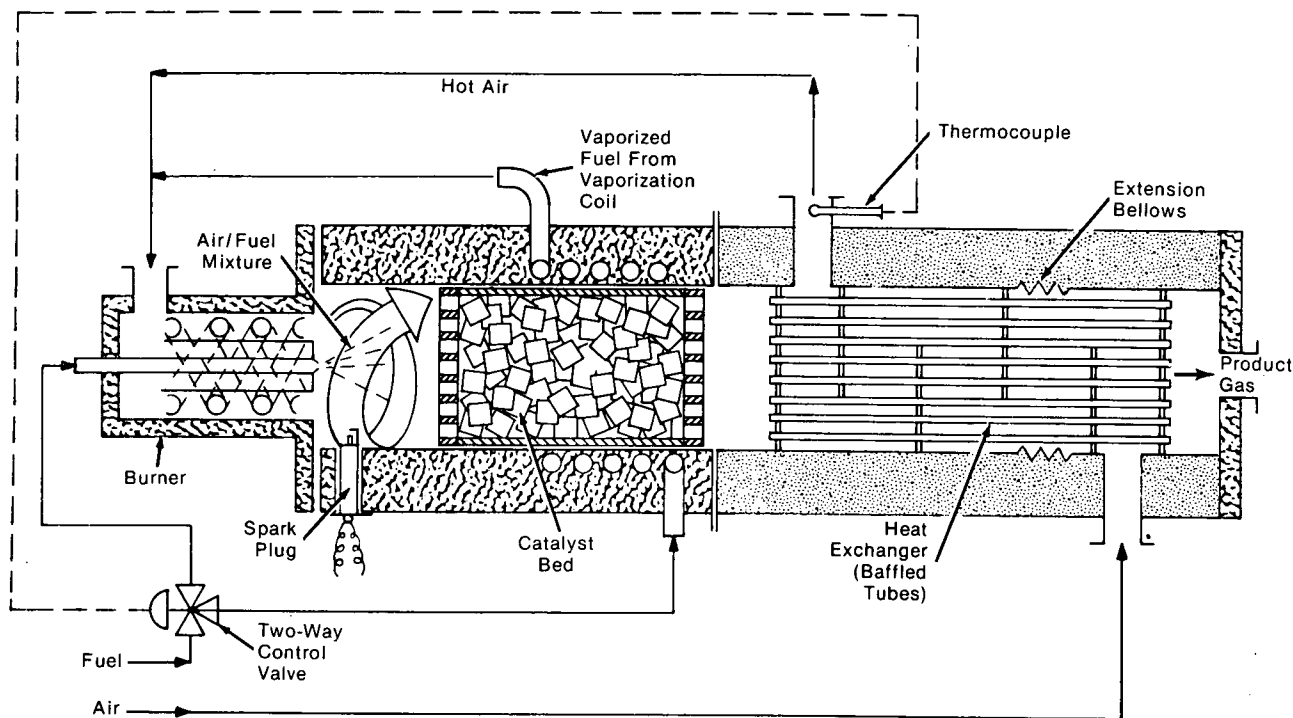


Figure 2. Catalytic Gas Generator

As shown in Figure 2, the catalytic gas generator is almost identical in construction and operation. It includes a catalyst bed in the reaction chamber to produce the hydrogen-rich gas. When the process is initiated, a thermal reaction is used as previously until the product gases heat the catalyst bed to a temperature of approximately 480°C (900°F). At that point there is an automatic transition from a reaction in the flame to a reaction on the surface of the catalyst. When the transition is complete, there is no longer a visible flame in the reactor chamber, and the temperature of the bed continues to rise to a steady-state temperature of approximately 980°C ($1,800^{\circ}\text{F}$). The resulting hydrogen-rich gas then is exhausted through the heat-exchanger tubes into the engine.

Basically, oxidation-type catalysts are used for the reaction of air and hydrocarbon. At the present time, commercially-available nickel catalysts have been tested with satisfactory results.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
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Reference: TSP75-10208

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457(f)], to the California Institute of Technology, Pasadena, California 91109.

Source: John Houseman and Donald J. Cerini of
Caltech/JPL
(NPO-13560 and NPO-13561)